

In Situ Manufacturing of Plastics and Composites to Support H&R Exploration, Phase II

Completed Technology Project (2005 - 2007)



Project Introduction

Makel Engineering and BAE Systems propose to develop processes to manufacture plastics and composites for radiation shielding based on In Situ Resources Utilization (ISRU). The production of plastics and composites will also serve as feedstock for In Situ Manufacturing of a variety of useful components, such as inflatable structures, replacement parts, etc. The direction set to NASA by the President on January 2004 placed high emphasis on a robust space exploration program. Affordable planning and execution of prolonged manned space missions depend upon the utilization of local resources (e.g., soil, atmosphere, etc.) and the waste products which are formed in manned spacecraft and surface bases. The purpose of the investigation is to develop materials and associated processing technologies for habitat structure on planetary surfaces to effectively shield humans and sensitive electronics such as solar arrays and integrated circuits from the harmful effect of deep space radiation environment. Unlike Earth, on the Lunar or Martian surface, there is practically no protection from primary deep space radiation sources such as Solar Particle Events (SPEs) and Galactic Cosmic Rays (GCRs). SPEs produce intermittent and extremely high fluxes of charged energetic particles associated with major solar flares.

Anticipated Benefits

While it is often difficult to identify near term commercial applications of technology directed to ISRU projects, there are significant near term commercial applications of this technology. Point of source processing is an emerging industrial market which is driving lower transportation costs and the economic conversion of waste products to valuable products. Fischer-Tropsch based chemical reactors are currently being used for applications such as syngas and clean diesel fuel production. An example is the production of syngas (a mixture of carbon monoxide and hydrogen) from hydrocarbon fuels. This application provides an alternative source to petrochemical refining for fine chemical production. Small scale Fischer-Tropsch reactors can be used to produce hazardous chemical at the point of use. This would eliminate the need to store and transport toxic chemicals. Distributed reactors would allow on-demand production of the quantity needed. The development envisioned in our program will synthesize ethylene, and, subsequently polyethylene. Polyethylene can be used in the construction of habitats, tools, and replacement parts. Assuming a successful Phase II program, our preliminary design will serve as a basis for an ISRU system that can be used Mars Exploration and settlement. We expect that the NASA/government market to be driven by NASA's Astrobiology and space exploration programs. We envision ISRU demonstration experiment and pilot scale payloads as part of future Mars landers. The in situ production of polyethylene and perhaps nutrients provide enormous cost savings for early Mars missions and therefore we are confident of early precursor flight experiment opportunities.



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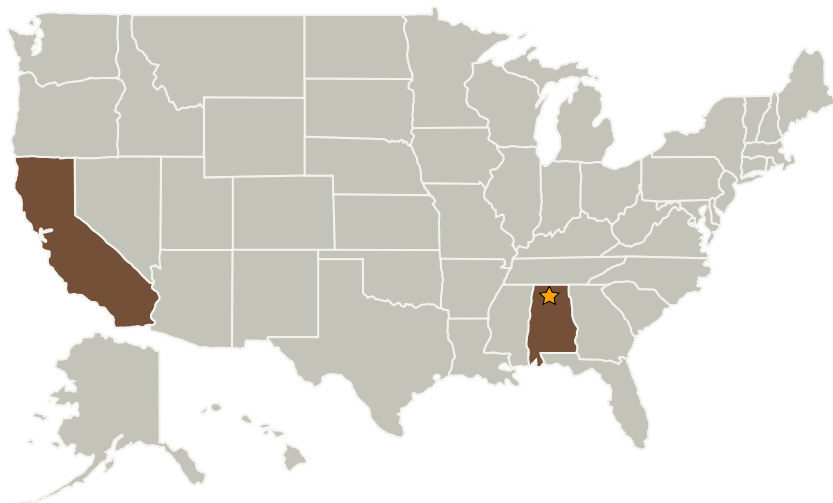
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Marshall Space Flight Center (MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Makel Engineering, Inc.	Supporting Organization	Industry Small Disadvantaged Business (SDB)	Chico, California

Primary U.S. Work Locations

Alabama	California
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Project Transitions

 **December 2005:** Project Start

 **November 2007:** Closed out

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Don Frazier

Principal Investigator:

Darby Makel

Technology Areas

Primary:

- TX07 Exploration Destination Systems
 - TX07.1 In-Situ Resource Utilization

Continued on following page.

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Technology Areas (cont.)

- └ TX07.1.4 Resource Processing for Production of Manufacturing, Construction, and Energy Storage Feedstock Materials